Review Article

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THE IMPACT OF THE RED DOT SYSTEM IN MEDICAL IMAGING: ENHANCING DIAGNOSTIC ACCURACY.

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ABSTRACT

The study discusses the implementation of Radiographer Abnormality Detection Systems (RADS) and the Red Dot System in medical imaging, particularly focusing on their impact on diagnostic accuracy and patient outcomes. It highlights the challenges faced with technological advancements and training gaps while emphasizing the evolving role of radiographers in image interpretation. Collaborative work between radiographers and radiologists is crucial for improving X-ray image quality and diagnostic accuracy. The study underscores the need for comprehensive training and ongoing education for radiographers to enhance their skills in detecting abnormalities and interpreting radiographs accurately. Despite some limitations, such as workload concerns and technological challenges, RADS and the Red Dot System offer substantial benefits in terms of patient care and radiographer job satisfaction. The study concludes that implementing these systems in healthcare can streamline diagnostic processes, reduce errors, and alleviate the workload on radiologists, ultimately leading to improved patient outcomes

Keywords: Abnormality Detection System, Education, Preliminary clinical evaluations, Radiographer, Training

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INTRODUCTION

Radiographer Abnormality Detection Schemes (RADS) were introduced in the UK during the early 1980s, enabling radiographers to mark potential abnormalities with a red dot on radiographs. This system has enhanced their role within emergency departments and requires specific training for implementation. Challenges have emerged with the advent of digital radiology and Picture Archiving and Communication Systems (PACS), affecting the implementation of RADS and subsequently impacting patient outcomes [1]. The aim of this study is to correlate the Red Dot System in medical imaging to enhancing diagnostic accuracy through the Red Dot System not only improves patient care and overall healthcare quality but also empowers radiographers to actively participate in diagnostic processes, reducing radiologists' workload and improving healthcare system efficiency by effectively integrating technology into diagnostic processes.

The RADS system was initially trailed at Ealing and Northwick Park Hospitals, with the results later published in 1985. This system allows radiographers to play a more active role in identifying abnormalities and assisting emergency doctors in making prompt and accurate diagnoses. Despite advancements in digital radiography, many healthcare departments still recognize the effectiveness of the red dot system and continue to utilize it as a tribute to its traditional role. Traditionally, radiographers primarily focused on acquiring diagnostic images but occasi onally offered informal opinions on abnormalities. Swinburne proposed the integration of image interpretation into emergency radiography in 1971, leading to discussions on radiographers' expanded diagnostic responsibilities. Berman's 1985 paper further explored

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this concept, advocating for radiographers to have a more substantial role in diagnostic processes, which could ultimately lead to improved patient outcomes. [2] [3]. Radiographers adopted a system where they placed a red sticker on radiographs to indicate abnormalities, aiding referrers before formal reports. This approach, known as the 'red dot system' or Radiographer Abnormality Detection System (RADS), improved their role in emergency teams [4]. The UK has utilized radiographer systems for identifying abnormalities for over 30 years, as advised by the Society and College of Radiographers, with a preference for preliminary clinical evaluations (PCE) or comments. This study seeks to update and evaluate current practices, continuing from a 2008 study [5].

Medical imaging has become an essential aspect of healthcare, providing physicians with crucial insights through radiographs. Roentgen's discovery of X-rays revolutionized medical diagnostics, and radiographers play a central role worldwide in the diagnostic process. They are often the first to evaluate images and collaborate closely with clinicians, influencing patient care positively. Diagnostic radiology, integral to diagnosing diseases and injuries, involves collaboration between clinical and radiology teams, emphasizing the importance of effective communication to prevent patient harm [6] [7] [8] [9]. The narrative starts with technologists marking findings in imaging with a "red dot," aiding radiologists in diagnosing diseases. During World War II, a shortage of radiologists led Weber State University to partner with the US Army, training numerous technologists (radiographers) to provide radiology diagnoses for patients (soldiers). Presently, US radiographers can interpret radiographs, sonograms, or CT scans if legislation permits them to do so [10].

Radiographers are not legally required to give diagnostic treatment or inform medical practitioners about abnormal exam results. A study found delays in radiograph reports, leading to higher mortality rates. Implementing the red dot system is suggested to help emergency doctors make quick and detailed diagnoses without radiologists [11] [12] [13] [14]. There are several studies already done on this topic. I just summarise few f these data in this literature below. One study was done in UK in the year of 2008, and it discovered that 92% of UK emergency departments incorporated some type of Radiographer Abnormality Detection System (RADS) in their radiography departments [3]. Additionally, a study in 2011 by the same researchers revealed a slight decrease in this figure to 88.6% [15]. The widespread adoption of RADS in the UK has not only enhanced diagnostics but also positively influenced emergency management by assisting junior doctors in interpreting trauma patients' radiographs [15] [16].

Another study utilized a quantitative approach and an anonymized radiographic image bank to assess radiographers' red dot performance. It involved approximately 70 qualified radiographers who completed image interpretation training and underwent a diagnostic accuracy test under controlled conditions. The analysis of 700 cases showed that 14 radiographers achieved an overall red dot sensitivity, specificity, and accuracy of 85%, 86%, and 85% respectively. Positive and negative predictive values were both 86%. Pathology-based sensitivity, specificity, and accuracy were 87%, 79%, and 83% respectively, resulting in an Area Under the Curve (AUC) value of 0.7 in the ROC curve [17]. A cross-sectional survey was conducted using a postal questionnaire to gather data on emergency departments and radiography services, including details about Radiographer Abnormality Detection Systems (RADS) and their implementation. A pilot study was done for questionnaire validation. 306 responses were received, with a higher response rate from hospitals with emergency departments compared to minor injury units [18].

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One more web-based study was done using questionnaire form among the 28 medical imaging department directors in Queensland public hospitals, with an 89% response rate. Results showed that 16% of respondents had a RADS in operation, while all others expressed interest in a trial. About 52% believed their staff lacked proper training for RADS implementation [4]. One study analysed radiographers' red dot or triage performance on accident and emergency A&E radiographs compared to a reference standard. Results showed varying sensitivity and specificity levels across body areas. Training did not significantly impact accuracy, suggesting that radiographers' performance is influenced by the specific area being evaluated [19]. One more study explores the evolution of radiographer abnormality detection systems in trauma radiographs, transitioning towards a radiographer commenting system. A cross-sectional survey involving radiographers from four hospitals in Queensland, Australia, examined their participation, perceptions, benefits, barriers, and enablers to radiographer commenting. Results showed varying levels of participation, with perceived benefits including improved patient care and professional development. Barriers such as limited access to image interpretation education and time constraints were noted, while enablers included education access and support from radiologist colleagues. Effective image interpretation education could enhance radiographers' readiness for abnormality detection and commenting in emergency settings [20] [21] [22] [23].

Tonks, A., Jimenez, Y., Gray, F., and colleagues' research indicated that after reviewing fourteen studies, a positive relationship was observed between radiographer image interpretation and enhancement in X-ray image quality. They highlighted factors such as improved skills and collaborative work as essential contributors to this improvement. This implies that utilizing radiographer image interpretation can enhance X-ray examinations, advocating for its incorporation into clinical practices and educational programs [24]. Oglat et al.'s study examines the red dot system's role in aiding radiologists by utilizing radiographers' expertise to detect and manage radiological abnormalities before radiologist reports. This practice, existing for over 20 years in the UK, is being considered for legal support. The research assesses the necessity and benefits of radiographer reports globally, analyzing 95 samples with statistical analysis indicating radiologists' support for radiographers' involvement in diagnosis assistance and clinical reporting via the red dot system, hinting at potential adoption in healthcare [25]. A study by Smith, Traise, and Cook (2009) found that rural radiographers improved their ability to interpret complex cases after a Continuing Education program. However, they need to enhance their use of radiological terminology, highlighting the importance of their role in healthcare teams [26].

Vincent et al. (1988) evaluated junior doctors' ability in accident and emergency settings to detect radiographic abnormalities. They analyzed 505 radiographs taken during nights and weekends over 8 months, finding a 35% error rate. The study suggests a need for formal training and guidance to improve SHOs' skills in radiographic interpretation [27]. Mackay (2006) conducted a study to assess the impact of a short course on radiographers' ability to detect fractures using the Red Dot system. The performance of 133 radiographers was evaluated before, immediately after, and 6 months' post-course using a sample of radiographs. Results showed significant improvements in fracture identification post-course, suggesting ongoing professional development is necessary for skill maintenance [28]. The study by Hargreaves and Mackay (2003) evaluated the effectiveness of a 10-week training program on radiographers' utilization of the red dot system in trauma radiology. Although statistical significance wasn't achieved, there was a noticeable enhancement in accuracy and fracture sensitivity following the training, indicating a beneficial effect of the program. Areas requiring further improvement were also pinpointed during the assessment [29].

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DISCUSSION

Research has evaluated radiographers' performance using RADS, showing good sensitivity, specificity, and accuracy. However, training gaps exist, with some departments lacking proper training for RADS implementation. Studies also highlight the evolving role of radiographers in image interpretation, with potential benefits for patient care and professional development. Collaborative work between radiographers and radiologists has shown positive outcomes, improving X-ray image quality and diagnostic accuracy. Additionally, studies emphasize the need for formal training and continuing education for radiographers to enhance their skills in detecting abnormalities and interpreting radiographs accurately. Overall, RADS have significantly impacted emergency radiography, but ongoing training and support are essential for optimal utilization and patient outcomes.

Radiographers' red dot systems play a crucial role in improving emergency radiography by assisting in the accurate identification of abnormalities. However, challenges such as technological advancements and insufficient training remain prevalent. Radiographers demonstrate comparable accuracy to ED doctors, but their performance significantly improves with comprehensive education and training programs [30]. Despite some limitations, such as providing limited information and potential workload concerns, these systems offer substantial benefits. They contribute to enhanced patient care, reduce the risk of missed abnormalities, and increase job satisfaction among radiographers. As technology evolves, there's a need to adapt reporting methods, transitioning from physical red dot stickers to digital annotations. Collaboration between radiographers and radiologists is essential for effective patient management in complex healthcare environments. This collaboration ensures efficient communication and decision-making, ultimately benefiting patient outcomes and improving the overall quality of emergency radiography services [31]. Several elements are likely to play a role in the successful integration of radiographer commenting alongside abnormality detection in emergency situations. Providing radiographers with comprehensive image interpretation education that suits their capabilities would be beneficial in preparing them for engaging in abnormality detection and commenting systems in emergency scenarios.

The introduction of the red dot system in the UK initially focused on trauma patients, but it resulted in a significant discrepancy between service demand and availability, exacerbated by a shortage of radiologists relative to the number of images. This accumulation of undiagnosed images added pressure to their workload. To address this, we propose a protocol where radiographers mark abnormal areas in images, aiding in diagnosis and reducing errors. Consequently, radiologists do not object to radiographers participating in diagnosis assistance, interpretation, and clinical reporting via the red dot system. Thus, there is substantial support for implementing such a system in healthcare to streamline diagnostic processes and alleviate the burden on radiologists.

CONCLUSION

This literature review has shown that Radiographer Abnormality Detection Systems (RADS) have good sensitivity, specificity, and accuracy but face training gaps. Radiographers' evolving role in image interpretation benefits patient care and professional growth. Collaboration with radiologists improves X-ray quality and diagnostic accuracy. Ongoing training is crucial for optimal use of RADS and improved patient outcomes.

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REFERENCE

1. Bickle I, McGuinness C, Murphy A, et al. Radiographer abnormality detection system. Reference article, Radiopaedia.org (Accessed on 15 Mar 2024) https://doi.org/10.53347/rID-56884
2. Berman L, de Lacey G, Twomey E, Twomey B, Welch T, Eban R. Reducing errors in the accident department: A simple method using radiographers. BMJ 1985; 290: 421– 2.
3. Snaith B, Hardy M. Radiographer abnormality detection schemes in the trauma environment—An assessment of current practice. Radiography 2008; 14: 277–81
4. Murphy A, Neep M. An investigation into the use of radiographer abnormality detection systems by Queensland public hospitals. J Med Radiat Sci. 2018 Jun;65(2):80-85. doi: 10.1002/jmrs.278. Epub 2018 Apr 29.
5. W. Harcus, B.J. Stevens, Radiographer abnormality flagging systems in the UK – A preliminary updated assessment of practice, Radiography, Volume 29, Issue 1, 2023, Pages 234-239, https://doi.org/10.1016/j.radi.2022.11.014 .
6. Ehrlich, R.A.; Coakes, D.M. Patient Care in Radiography-E-Book: With an Introduction to Medical Imaging; Elsevier: Amsterdam, The Netherlands, 2016
7. Oglat, A.A. Performance Evaluation of an Ultrasonic Imaging System Using Tissue- Mimicking Phantoms for Quality Assurance. Biomimetics 2022, 7, 130.
8. Allen, B.; Chatfield, M.; Burleson, J.; Thorwarth, W.T. Improving diagnosis in health care: Perspectives from the American College of Radiology. Diagnosis 2017, 4, 113– 124
9. Zheng, Y.; Comaniciu, D. Marginal Space Learning for Medical Image Analysis; Springer: New York, NY, USA, 2014.
10. Oglat AA, Fohely F, Masalmeh AA, Jbour IA, Jaradat LA, Athamnah SI. Attitudes toward the Integration of Radiographers into the First-Line Interpretation of Imaging Using the Red Dot System. Bioengineering. 2023; 10(1):71. https://doi.org/10.3390/bioengineering10010071
11. Erdogan, N.; Imamoglu, H.; Gorkem, S.B.; Dogan, S.; Senol, S.; Ozturk, A. Preferences of referring physicians regarding the role of radiologists as direct communicators of test results. Diagn. Interv. Radiol. 2017, 23, 81–85.
12. Smith, L. The red-dot system in medical imaging: Ethical, legal and human rights considerations. Radiographer 2006, 53, 4–6.
13. Snaith, B.A. Radiographer-led discharge in accident and emergency—The results of a pilot project. Radiography 2007, 13, 13–17.
14. Okeji, M.C.; Udoh, B.E.; Onwuzu, S.W. Appraisal of reporting of trauma images: Implications for evolving red-dot system in Nigeria. ARPN J. Sci. Technol. 2012, 2, e5
15. Snaith B, Hardy M, Lewis E. Reducing image interpretation errors – Do communication strategies undermine this? Radiography 2014; 20: 230–4
16. Hall R, Egan I, Kleeman S. The Red Dot System: The outback experience. The Radiographer 1999; 46: 83–7.
17. Beth O'Leary, Andrew England, Grainne Curran, et. al. (2024). Diagnostic accuracy of radiographers' red dot usage in the emergency department, Journal of Radiation Research and Applied Sciences, Volume 17, Issue 1, 2024, 100795, https://doi.org/10.1016/j.jrras.2023.100795.
18. Snaith B, Hardy M, Radiographer abnormality detection schemes in the trauma environment An assessment of current practice, Radiography (2007), doi:10.1016/j.radi.2007.09.001

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ISSN: XXXX-XXXX

19. Brealey, S., Scally, A., Hahn, S., Thomas, N., Godfrey, C., & Crane, S. (2006). Accuracy of radiographers red dot or triage of accident and emergency radiographs in clinical practice: a systematic review. Clinical radiology, 61(7), 604–615. https://doi.org/10.1016/j.crad.2006.01.015
20. Neep MJ, Steffens T, Owen R, McPhail SM. Radiographer commenting of trauma radiographs: A survey of the benefits, barriers and enablers to participation in an Australian healthcare setting. J Med Imaging Radiat Oncol 2014; 58: 431–8
21. Berman L, de Lacey G, Twomey E, Twomey B, Welch T, Eban R. Reducing errors in the accident department: a simple method using radiographers. BMJ 1985; 290: 421– 422.
22. Brealey S, Scally A, H ahn S, Thomas N, Godfrey C, Crane S. Accuracy of radiographers red dot or triage of accident and emergency radiographs in clinical practice: a systematic review. Clin Radiol 2006; 61: 604–615.
23. Hardy M, Culpan G. Accident and emergency radiography: a comparison of radiographer commenting and 'red dotting. Radiography 2007; 13: 65–71.
24. Tonks, A., Jimenez, Y., Gray, F., & Ekpo, E. (2024). A stake in the game: Can radiographer image interpretation improve X-ray quality? A scoping review. Radiography (London, England : 1995), 30(2), 641–650. https://doi.org/10.1016/j.radi.2024.01.017
25. Oglat, A. A., Fohely, F., Masalmeh, A. A., Jbour, I. A., Jaradat, L. A., & Athamnah, S. (2023). Attitudes toward the Integration of Radiographers into the First-Line Interpretation of Imaging Using the Red Dot System. Bioengineering (Basel, Switzerland), 10(1), 71. https://doi.org/10.3390/bioengineering10010071
26. Smith, T. N., Traise, P., & Cook, A. (2009). The influence of a continuing education program on the image interpretation accuracy of rural radiographers. Rural and remote health, 9(2), 1145.
27. Vincent, C. A., Driscoll, P. A., Audley, R. J., & Grant, D. S. (1988). Accuracy of detection of radiographic abnormalities by junior doctors. Archives of emergency medicine, 5(2), 101–109. https://doi.org/10.1136/emj.5.2.101
28. Mackay S. J. (2006). The impact of a short course of study on the performance of radiographers when highlighting fractures on trauma radiographs: "The Red Dot System". The British journal of radiology, 79(942), 468–472. https://doi.org/10.1259/bjr/53513558
29. Hargreaves J, Mackay S, (2003). The Accuracy of the red dot system: can it improve with training? Radiography. DOI: https://doi.org/10.1016/j.radi.2003.09.002
30. Brealey S., Scally A., Hahn S., Thomas N., Godfrey C., Crane S., 2006. Accuracy of radiographers red dot or triage of accident and emergency radiographs in clinical practice: a systematic review. Clinical Radiology, 61(7), 604-615.
31. Brealey S., Scally A., Hahn S., Thomas N., Godfrey C., Coomarasamy A., 2005. Accuracy of radiographer plain radiograph reporting in clinical practice: a meta- analysis. Clinical Radiology, 60(2), 232-241